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## ABSTRACT

Rural communities in the West have lost jobs in traditional (i.e., resource based) industries, a change that has prompted a search for new employment opportunities. High-tech manufacturing has been the focus of considerable attention because of its potential for continued rapid growth. Many high-tech industries are dispersing geographically to small urban areas and nonmetropolitan counties. The growth, employment, and decentralization characteristics of high-tech manufacturing industries indicate their potential to generate employment opportunities in nonmetropolitan economies. This report, the product of a study that surveyed 280 high-tech and 301 low-tech establishments in nonmetropolitan counties in 11 western states presents the following conclusions: (1) small towns and rural counties are not at any particular disadvantage although greater percentages of large plants and branch plants locate in metropolitan-adjacent counties; (2) high-tech plants generate as many jobs as traditional plants; (3) the structure of occupations differs between high-tech and low-tech and between branch and single unit plants; (4) high-tech plants employ higher percentages of women, concentrated in lower skilled production occupations; and (5) high-tech plants purchase a lower percentage of local nonlabor inputs than low-tech plants. Statistical data are reported in tables and graphs. A list of high technology industries is included as an appendix. This report contains 10 references. (ALL)

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# Local Economic Impacts of High Technology Manufacturing in the Nonmetropolitan West

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COMMUNITY  
ECONOMICS 

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**WRDC**

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# Local Economic Impacts of High Technology Manufacturing in the Nonmetropolitan West

Can rural communities in the West expect to be the location for high technology manufacturing, and if so, what types of local economic impacts can they anticipate? These two questions have arisen in the 1980s as rural communities lost jobs in their traditional, resource-based industries, leading them to search for new employment opportunities. High tech manufacturing has been the focus of considerable attention because these industries have grown rapidly, and are expected to continue doing so.

There is evidence that high tech industries have the potential to provide new employment opportunities. From 1972 to 1981, 87 percent of U.S. manufacturing employment growth occurred in the high technology industries. Projections through the mid-1990s, using moderate assumptions, show employment in high tech industries growing by 14.1 percent vs. 6.6 percent for all manufacturing (Clair; U.S. Department of Labor). Moreover, recent research also shows that many high tech industries are dispersing geographically to small urban areas and non-metropolitan counties (Markusen et al.; Barkley). Thus, the growth, employment and decentralization characteristics of high tech manufacturing industries indicate that they have the potential to generate employment opportunities in non-metropolitan economies.

There are other issues besides simply generating more jobs, however. One is the type of jobs created and how they meet the needs and desires of a community. A second is the extent to which high tech manufacturing generates

further local economic activity through nonlabor input purchases. A third issue is whether or not high tech manufacturing is any different, or better, in these respects than other manufacturing industries. The following information should help communities assess the potential that high tech manufacturing may have for meeting economic development and job creation goals.

The next section of this publication defines high tech industries and discusses the data collection. This is followed by a summary of several characteristics of the manufacturing establishments sampled, and their locations. The fourth section examines the community impacts of the high tech and low tech or traditional manufacturing plants. The types of impacts examined include employment generated, occupational characteristics of the labor force, and the importance of local input purchases. The final section summarizes the study and draws policy implications.

## Data Definitions and Sources

Definitions of high technology industries vary. The definition used in this study was developed in 1983 by Armington, Harris and Odle of The Brookings Institute. This definition classified an industry as high technology if (1) more than 8 percent of its employees were in scientific, engineering or technical occupations and at least 5 percent of industry employment was in the more narrow class of scientific and engineering occupations, or (2) the proportion of expenditures for research and development relative

to product sales exceeded the national average. Eighty manufacturing industries (4-digit Standard Industrial Classification - S.I.C.) were identified under this criteria (See Appendix for list).

This study is based on data from a mail survey (following Dillman's method) of 927 high technology and low technology manufacturing firms located in nonmetropolitan counties in eleven western states—Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. The sample frame was the manufacturing directory for each state for 1985 or 1985-86, except for Washington, for which only the 1984-85 directory was available. All non-metropolitan counties in each state were identified, and all high tech establishments (565) listed in the directories for those counties were selected for the survey. A sample of 362 low tech establishments were selected from the same counties.<sup>1</sup> The total number of responses was 638, for an overall response rate of 68.8 percent. The usable response rate was 62.7 percent, including 280 high tech and 301 low tech establishments.

<sup>1</sup> The low tech establishments were selected with the following procedure. A 10 percent sample with a random start was drawn from each state, except for a 5 percent sample from Oregon. This was done because Oregon had a much larger directory than any other state, and a 10 percent sample would have over-represented the state, particularly small wood processing firms.

## General Characteristics of the Establishments

**Ownership type.** The establishments in the sample were divided into three ownership types—headquarters with branch plants, branch plants, and single unit plants. Over 70 percent of the sample were single unit plants, 19 percent were branches, and less than 10 percent were headquarters. These percentages are about the same for both high and low technology categories.

The ownership type varied considerably with plant size. Establishments with less than 10 employees were primarily single unit plants (87 percent), and less than 8 percent were branch plants. Among plants with 10 or more employees, single unit plants made up only 60 percent of the establishments, while branch plants were almost 27 percent of the total. Also the percentage of branch plants was higher and single unit plants lower for high tech establishments with 10 or more employees.

**Age.** There were statistically significant age differences between large and small establishments, between high and low tech establishments overall and within ownership types, and between ownership types within size groupings. (Age equals the difference between the year 1985 and the year operations started at the plant.) The high tech establishments were on average 10 years younger than low tech plants (14.7 vs. 25.2). Also, the smaller establishments (less than 10 employees) averaged 16.5 years vs. 22.5 years for the larger category. The high tech establishments were younger for both size groups and for the three ownership types.

Table 1. Percentage of High Tech Establishments Located in Towns of Different Size, by Establishment Size

| Establishment Size | Town Size      |           |               |                |
|--------------------|----------------|-----------|---------------|----------------|
|                    | Less than 2500 | 2500-9999 | 10,000-24,999 | 25,000 or more |
| Less than 10       | 24.2*          | 12.6      | 23.2          | 40.0           |
| 10-25              | 22.1           | 24.7      | 15.6          | 37.7           |
| 26-99              | 20.0           | 29.2      | 23.1          | 27.7           |
| 100 or more        | 11.8           | 23.5      | 35.3          | 29.4           |
| All establishments | 21.0           | 21.4      | 22.5          | 35.1           |

\* Figures are the percentage of establishments in the respective establishment size category that are located in each town size category.

**Location.** The types of places that high tech manufacturers locate is crucial to rural communities' efforts to include these industries in economic development efforts. Do high tech establishments tend to locate in certain size communities, and do they locate in counties adjacent or not adjacent to metropolitan counties?

Smaller towns do not appear to be at a major disadvantage as locations for high tech manufacturing (Table 1). Over one fifth of the high tech establishments in the sample were in towns with populations less than 2500. This is the same percentage for towns of 2500-10,000, and 10,000-25,000. Towns of 25,000 or more were slightly more favored, with 35 percent of the high tech plants. At the same time, there is only a slight, and not consistent, pattern of larger plants preferring larger towns. The smallest towns (less than 2500) have a much lower percentage of the largest plants, but for other plant sizes, the differences are small when they exist.

Overall, counties adjacent to metropolitan counties had a higher percentage of the high tech plants, 57 percent vs. 43 percent. There are important differences, however, when the size of plants is consid-

ered (See Figure 1). Larger high tech plants were more likely to be located in counties adjacent to a metropolitan county, and high tech plants in nonadjacent counties were usually smaller. Of the high tech plants located in nonadjacent counties, over 41 percent had less than 10 employees, and 75 percent had 25 or fewer employees, whereas, in the adjacent counties, almost half the plants had more than 25 employees.

## Community Impacts

Of constant interest to community leaders is how many jobs a plant will provide. Beyond the simple presence of a plant in a community and the direct jobs generated, there are other factors that determine a plant's contribution to the local economy. One is the kinds of jobs generated. Another is the linkages with other local business and industry; the amount of nonlabor inputs the plant purchases locally. This section will compare these impacts for the high and low tech manufacturers.<sup>2</sup>

### Size of the establishments.

The average size for all high tech establishments was 52 employees,

<sup>2</sup> See Smith and Barkley, and Barkley, Dahlgran and Smith for further details.

**Figure 1.** Percentage of high tech manufacturers in counties adjacent and nonadjacent to metropolitan counties, by establishment size

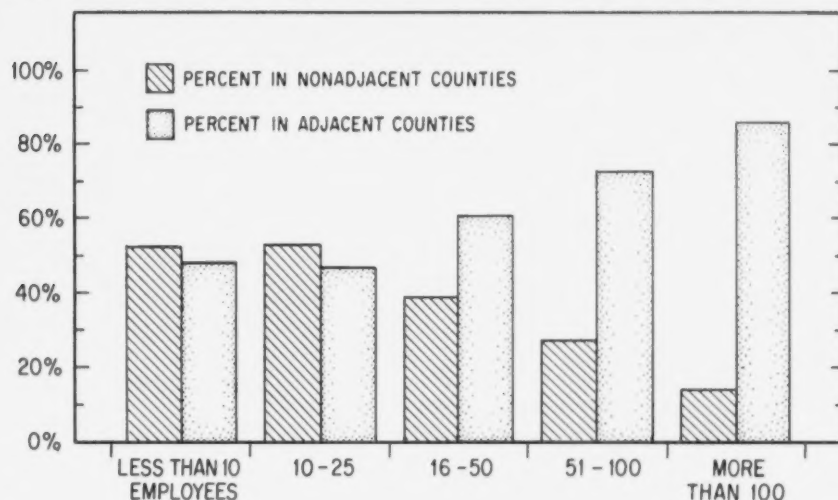
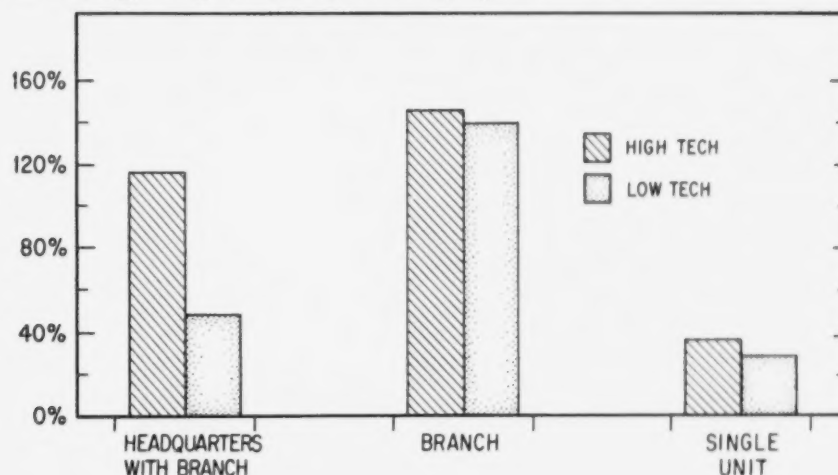


**Figure 2.** Average number of employees per establishment type and technology categories, 10 or more employees



and 31.6 employees for all low tech establishments. For size categories of less than 10 and 10 or more employees, the average size was 4.8 and 68.7 employees, respectively. Within the category of 10 or more employees, the high tech establishments averaged 78.3 vs. 57.1 employees for the low tech. In the smaller category, the high and low tech establishments were virtually the same size, at 4.9 and 4.7 employees.

Branch plants are larger than both headquarters and single unit establishments. These differences are slight for establishments with less than 10 employees, but considerable for the larger size category. For establishments in the 10 or more category (Figure 2), high tech branch plants average 145 employees vs. 116 for headquarters and 36 for single unit plants. A similar distribution exists for low tech establishments. Thus in the West, communities can generally expect high tech plants to provide more jobs than low tech plants, with branch plants providing considerably more jobs.

**Occupational characteristics of the workforce.** Table 2 shows the average percentage of employees in each occupational category, by high and low tech establishments, and for the entire sample

**Table 2.** Average Percentage of Employees in Each Occupation by Technology and Establishment Size.

| Occupational Category        | Entire Sample |          | ≥10 Employees |          | <10 Employees |          |
|------------------------------|---------------|----------|---------------|----------|---------------|----------|
|                              | High Tech     | Low Tech | High Tech     | Low Tech | High Tech     | Low Tech |
| Executives .....             | 18.4%         | 18.0%    | 13.2%         | 11.9%    | 28.1%         | 24.7%    |
| Professional .....           | 14.5          | 5.2***   | 12.1          | 5.6***   | 18.1          | 4.6***   |
| Sales .....                  | 5.5           | 6.5      | 5.2           | 6.6      | 6.0           | 6.4      |
| Clerical .....               | 9.2           | 9.3      | 8.4           | 8.2      | 10.4          | 10.6     |
| Precision Production .....   | 20.3          | 20.6     | 20.2          | 17.7     | 20.8          | 23.8     |
| Operators; Fabricators ..... | 25.1          | 26.4     | 32.5          | 31.7     | 12.1          | 20.5***  |
| Laborers .....               | 7.0           | 14.0***  | 8.4           | 18.3***  | 4.4           | 9.4**    |

\*\* Means significantly different at the .05 level.

\*\*\* Means significantly different at the .01 level.

and two size groups. While the percentage of employees in most occupations was similar between high and low tech establishments, there were important differences. Key differences are in the highest and lowest skilled occupations—professional and laborers. For the sample as a whole, the high tech establishment averaged 14.5 percent of their employees in the professional category vs. .5 percent for low tech establishments. In the laborer category, the average was 7 percent for high tech and 14 percent for low tech establishments. Thus, relative to low tech, high tech manufacturers had approximately three times the percentage of employees in the most highly skilled category, and one-half the percentage in the lowest skilled category.

These occupational differences hold for both small and large size establishments. In both size categories, the high tech establishments had much higher percentages of professional employees, and much lower percentages of laborers. In addition, the small high tech establishments had a significantly lower percentage of employees in the lower skilled operator/fabricator category (12 vs. 20.5 percent). This last result is not surprising. The smaller plants are generally younger, and thus more likely to be in the development stages of their product. Such work requires higher, rather than lower skilled labor.

A comparison of branch and single unit plants shows important differences between the types of establishments (Table 3). The high tech unit plants had significantly higher percentages of professional

Table 3. Average Percentage of Employment in Each Occupation for Branch and Single Unit Plants, by Technology.

| Occupational Category  | Branch Plants |          | Single Unit Plants |          |
|------------------------|---------------|----------|--------------------|----------|
|                        | High Tech     | Low Tech | High Tech          | Low Tech |
| Executives             | 12.4%         | 10.8%    | 20.9%              | 19.5%    |
| Professionals          | 10.1          | 6.8      | 16.1               | 4.8***   |
| Sales                  | 4.0           | 7.1*     | 5.4                | 5.9      |
| Clerical               | 7.9           | 8.6      | 9.6                | 9.2      |
| Precision Production   | 17.6          | 15.8     | 22.0               | 21.1     |
| Operators; Fabricators | 36.5          | 35.8     | 20.8               | 25.1     |
| Laborers               | 11.4          | 15.1     | 5.2                | 14.3***  |

\* Means significantly different at .10 level.

\*\* Means significantly different at .05 level.

\*\*\* Means significantly different at .01 level.

plants, and significantly lower percentages of laborers. Among *branch* plants, however, the picture is much different. There were no statistically significant differences between the high and low tech branch plants (except that shown for sales). Branch plants, whether or not they are high or low tech manufacturing, can be expected to have similar labor force compositions. Thus, the percentages of professional or skilled workers employed by high and low tech branch plants is not likely to be different.<sup>3</sup>

There also were differences between branch and single unit plants within technology categories (not shown in tables). Low tech branch plants employed a lower percentage of skilled production workers (precision production) and a higher proportion of less skilled production workers (operators/fabricators) than low tech unit plants. Within the high tech category, unit plants had higher proportions of employees than branch plants in both the professional and precision production occupations, and much lower

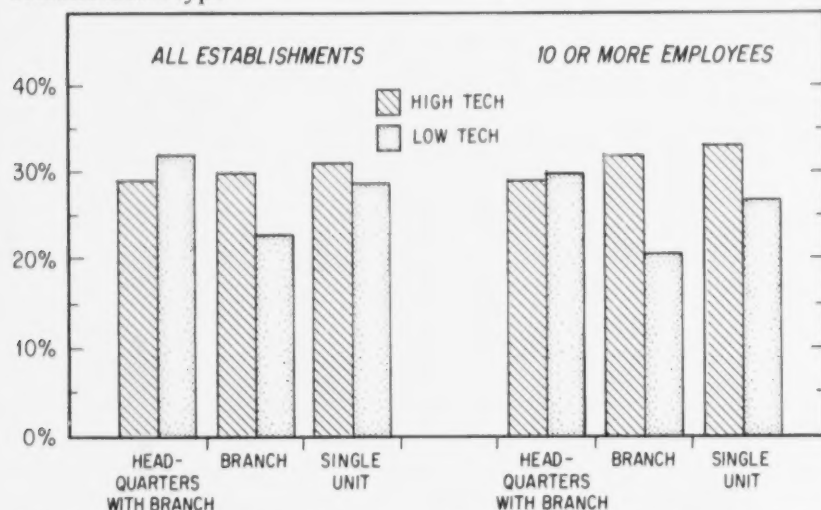
proportions in the less skilled occupations of operator/fabricator and laborers. Thus, branch plants, whether high or low tech, have workforces concentrated in the less skilled production occupations, which is characteristic of the established, routine production processes that decentralize to rural areas.

The high technology establishments in the study also exhibited the typical high tech characteristic of a relatively large percentage of employees working in research and development (R & D). For example, the percentage of employees working in R & D for the larger (10 or more employees) high tech establishments was 10.8 percent vs. 4.2 percent for the low tech establishments. This large difference held for all ownership types of firms.

The most interesting differences regarding R & D employment perhaps are those between branch plants and the other types for both high and low tech, and the difference between the high and low tech branch plants. In general, branch plants would not be expected to have R & D employment, particularly in rural areas, because branches exist efficiently to pro-

<sup>3</sup> These results were similar for small and large size plants, except that the larger high tech unit plants had higher percentages of executives and precision production workers.

**Figure 3.** Average percentage of women employees, by technology and establishment type



duce an already-developed product. Among high tech plants, the percentage of employees in R & D was more than twice as high in the single unit and headquarters plants as in the branch plants (13.0 percent vs. 5.2 percent). This difference was greater among low tech plants, where the percentage of R & D employees in single unit and headquarters plants was five times that in branch plants (5.5 percent vs. .9 percent). Thus, the overall expectation is borne out, as branch plants clearly focus on activities that require the standard production skills. Nevertheless, differences between high and low tech branch plants exist. The high tech branches had an average percentage of R & D employment almost six times that of low tech branches.

In sum, there were distinct differences in the occupational structures between high and low tech establishments and between branch and unit plants. The high tech establishments in the nonmetropolitan counties in the West were

similar to high tech industries in general. They had higher percentages of employees in the more highly skilled occupations, and lower percentages in the lower skilled occupations. These differences, however, were accounted for primarily by the single unit plants, as there were no statistically significant differences between high and low tech branch plants.

A pattern of differences also existed between unit and branch plants, particularly in the high tech category. The unit plants employed higher percentages of professionals and skilled production workers, and lower percentages of less skilled production workers and laborers. One explanation of these differences lies in the functions performed by each. Unit plants need more skilled workers because they perform the range of manufacturing functions including research and development, and machine and product design. Branch plants, on the other hand, focus largely on routine production activities that

require primarily machine operation and product assembly.<sup>4</sup>

**Sexual composition of the workforce.** Another important aspect of the kinds of jobs generated by high tech manufacturing is the distribution between men and women. As job opportunities continue to decline in the male-oriented industries of farming, mining, forestry and related processing, rural families increasingly rely on the earnings of women. The existence of employment opportunities for women in growing industries will contribute significantly to alleviating economic stress on rural families and communities.

In the establishments studied, high tech plants employed a slightly higher percentage of women than low tech plants, 31 vs 28 percent. Among plants with 10 or more employees, the difference widened to 32.5 vs. 26 percent, which is statistically significant. Figure 3 shows that branch plants primarily account for these differences. For both the sample as a whole and plants with 10 or more employees, high tech branch plants employed significantly higher percentages of women than low tech branches (30 vs. 23 percent, and 32 vs. 21 percent, respectively). The larger, single unit, high tech plants also employed higher percentages of women (33 percent) than low tech unit plants (27 percent).

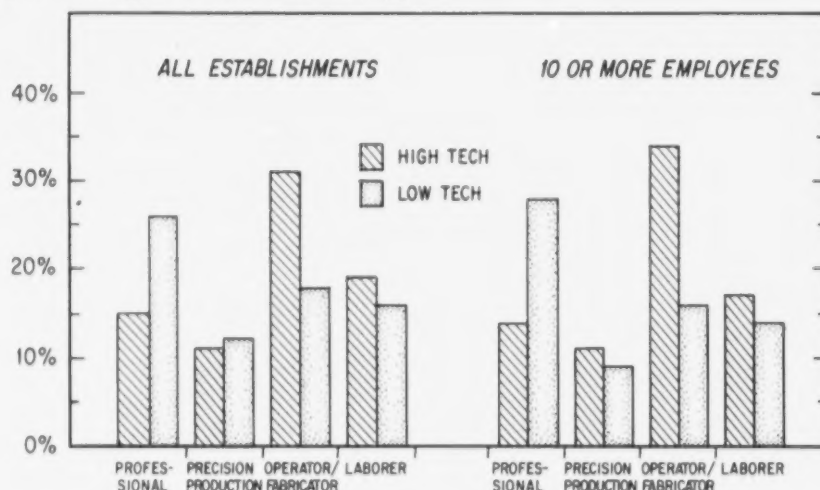
A more complete picture of women's employment opportunities emerges in Figure 4, which compares the percentage of women employed in selected occupations

<sup>4</sup> More detailed analysis, that accounts for other factors, confirms these results (see Barkley, Dahlgran and Smith).

in high and low tech plants. High tech manufacturers employed much higher percentages of women in the lower skilled production and laborer occupations. In the professional occupations, however, the percentage of women was about twice as high in low tech manufacturing. These differences also hold for each type of establishment (headquarters, branch, single unit) and plant size categories. Thus, while high tech plants employed a higher percentage of women overall, they did so only in the lower skilled production occupations. The low tech plants, on the other hand, provided considerably higher percentages of jobs for women in the professional occupations.

**Local input purchases.** The nonmetropolitan, economic development potential of high tech manufacturing cannot be estimated solely on the basis of direct employment generated. New industries create markets and stimulate demand for inputs (backward linkages), and thus broaden and deepen the local economy. Industries with strong backward linkages provide the impetus for a more dynamic economy and long term economic growth. Where local input linkages are absent, local income and employment multipliers will be low, and local income and employment expansion will be limited to increases in those activities that serve the workers and families in the new industry (Erickson). Thus, if high and low tech manufacturers maintain different market linkages, the aggregate local employment and income generated by manufacturers in these sectors may differ greatly.

**Figure 4.** Average percentage of women employees in each occupation, by technology and establishment type



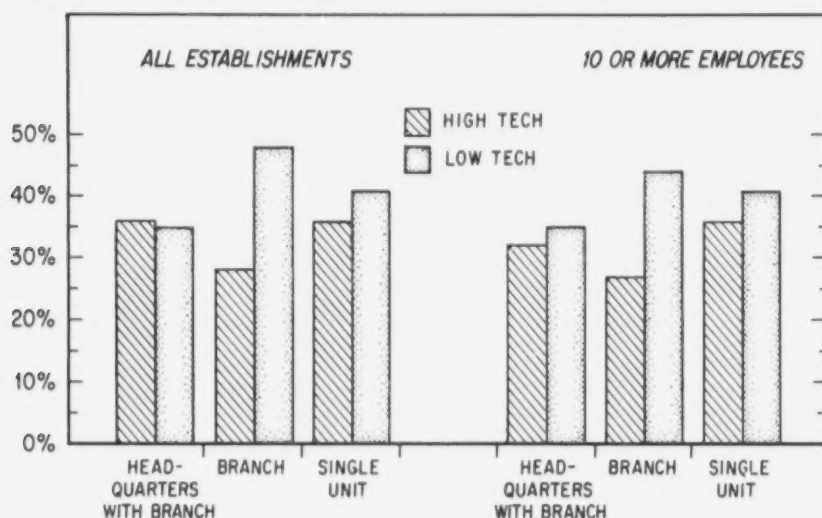
Levels of local (county) input linkages are shown in Figure 5 for technology categories and establishment size. The pattern is the same for all establishments and plants with 10 or more employees. Overall, the high tech establishments purchased a statistically significant lower percentage of nonlabor inputs in the county than low tech establishments (34.4 vs. 41.8 percent). This difference was most pronounced among branch plants, with low tech branches purchasing almost half of their nonlabor inputs locally, versus less than 28 percent for high tech branches. Among single unit plants, low tech local purchases also were greater than high tech (41.3 vs. 36.4 percent), but there was little difference among headquarters establishments.<sup>5</sup>

Additional analysis showed that besides technology and establishment type, other factors influenced

<sup>5</sup> From another perspective, 35 percent of the low tech plants vs. 28 percent of the high tech purchased over half of their inputs locally.

the level of local input purchases. The longer a plant was in its location, the less it tended to purchase locally. Larger plants, in particular, showed this tendency. This result was contrary to expectations, since it is generally believed that as businesses stay in an area longer, they either find local suppliers, or suppliers start up to provide needed inputs, thus increasing local purchases. Certain characteristics of a plant's location also strongly influenced local purchases. Plants located in counties adjacent to metropolitan counties tended to purchase less locally. Furthermore, as the number of manufacturing employees in the nearest metropolitan area increased, local input purchases decreased. This implies that local manufacturing plants are purchasing inputs from larger nearby metropolitan areas, either because local suppliers do not exist or because they are not competitive. On the other hand, the results showed that larger

**Figure 5.** Average percentage of nonlabor input purchases made in the county, by establishment type and technology category



nonmetropolitan communities counter the effects of metropolitan areas. Plants located in more populous nonmetropolitan counties captured higher percentages of nonlabor input purchases. However, even after taking account of these other factors, the differences in the level of local input purchases between high and low technology plants still exists, particularly among branch plants and the larger plants. High tech plants will tend to purchase lower percentages of nonlabor inputs locally.

## Summary and Implications

**Summary.** In the 1980s, rural economic development efforts increasingly have emphasized high technology manufacturing. This focus is based on evidence showing that high technology manufacturers (1) provide a source of rapid employment growth while the potential job outlook in agriculture, mining, forestry, and traditional rural manufacturing is gloomy; (2) provide employment opportunities for professional and skilled production labor, and as a result, increase the availability of higher paid jobs; and (3) are beginning to decentralize to smaller cities and rural areas.

The purpose of this study was to examine the characteristics of the high technology manufacturing establishments locating in nonmetropolitan counties of the West, and to determine the nature of their contribution to the local economy. The investigators found that small towns and rural counties were not

at any particular disadvantage as locations for high tech establishments. There are few differences in the percentage of high tech plants that are located in counties adjacent and not adjacent to metropolitan counties, or in different size towns. The main difference is that greater percentages of larger plants and branch plants choose locations in adjacent counties and in towns over 25,000 in population.

The research also showed that communities can expect high tech plants to generate at least as many jobs per plant as the traditional "low tech" manufacturing plants. High tech branch and single unit plants are slightly larger than similar low tech establishments, and high tech headquarters with branches elsewhere average more than twice as many employees as similar low tech plants.

There are, however, distinct differences in the occupational structures between high and low tech establishments, and between branch and single unit plants. The high tech establishments in the nonmetropolitan counties in the West are similar to high tech industries in general. They have higher percentages of employees in the more highly skilled occupations, and lower percentages in the lower skilled occupations, although these differences occur primarily in single unit plants, as there are not statistically significant differences between the occupational mix of high and low tech branch plants. A pattern of occupational differences also exists between single unit and branch plants, particularly in the high tech category. The single unit plants employ higher percentages of professional and skilled produc-

tion workers, and lower percentages of less skilled production workers and laborers than branch plants. Thus, a branch plant, whether high or low tech, will provide similar types of employment opportunities.

Differences also exist when employment is examined by sex. High tech plants employ higher percentages of women than low tech plants. This is particularly true for branch plants. The high tech jobs for women, however, are concentrated in the lower skilled production occupations. Low tech industries, on the other hand, provide considerably higher percentages of jobs for women in the professional and skilled production occupations. Thus, if employment opportunities for women are a local development goal, high tech industries may provide them, but will tend to do so primarily in lower skilled occupations.

A final local economic impact is the linkages of high tech manufacturers to other local economic sectors. High tech plants, both large and small, purchase a lower percentage of their nonlabor inputs locally than low tech plants. A particular difference is that high tech *branch* plants purchase a much lower percentage of nonlabor inputs locally than low tech *branch* plants. This was not unexpected because high tech products require many specialized inputs that are produced in relatively few locations.

**Implications.** The findings of this study provide at least partial answers to several questions about the role of high tech manufacturing in rural economic development. The first question that must be answered is, will such establish-

ments locate in rural communities? Previous research, and the companion to this publication (Barkley, Keith and Smith) found that there has been rapid growth of these industries in nonmetropolitan counties in recent years. The community- and plant-level data reported here show that both small towns and counties not adjacent to metropolitan areas are locations for high tech plants. Larger towns and counties adjacent to metropolitan areas are locations for higher percentages of the high tech plants, especially the larger ones, but the differences are not great. Thus, the goal of attracting high tech industry to nonmetropolitan areas is realistic.

A second question concerns whether high tech industries can create as much employment as traditional manufacturing. The answer appears to be "yes" on two counts. One is that growth in manufacturing jobs over the past 15 years, and projected future growth, has been primarily in the high tech sectors. The second is that the high tech industries studied in the nonmetro West generated more total employment per plant than the low tech manufacturers.

A third issue concerns the differences in impacts between types of plants—branch vs. locally owned, single unit plants. Knowledge of these differences is important because local development policies that focus on one type of plant may not fit the other. Branch plants are the focus of external recruitment efforts, while programs for indigenous firms imply policies designed to help generate, retain, or expand businesses.

If a branch plant of a high tech firm is the target, or most likely opportunity, the resulting employment impacts will be similar to those of branch plants of any industry. Different jobs, particularly professional and skilled production jobs, generally will not be provided. While this may not meet goals of upgrading the local workforce, the match with local labor skills may be better. The jobs being lost, and thus needed, in most nonmetropolitan communities are not highly skilled or technical. Also, job opportunities for women are relatively good in the low skilled production occupations of the high tech industries, but not in the professional job categories.

Three-fourths of the high tech establishments are not branch plants, however. The single unit and headquarters establishments provide significantly higher percentages of research and development, and professional, technical and skilled production jobs. These firms are more than just routine assembly operations, and although they provide fewer total jobs per plant than branches, smaller communities can more easily absorb smaller businesses. As these businesses grow, the community can more easily match their incremental service, labor and infrastructure needs. Furthermore, these businesses tend to be "home grown," and are thus good candidates for retention and expansion or entrepreneurial assistance programs. In many cases such efforts represent more efficient use of a community's or state's scarce development resources than attempting to recruit branch plants.

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A final issue is the strong tendency for high tech manufacturers to purchase fewer nonlabor inputs locally than low tech establishments. This is especially applicable to high tech branch plants—the likely focus of recruitment efforts, or of the expansion/decentralization tendencies of metropolitan-based firms. Communities that are recipients of high tech manufacturing will benefit from the direct employment, but much less from backward linkages, relative to low tech industries. Thus, attracting the high tech plant may be easier than getting it to purchase inputs locally, and communities will have to put special effort into taking advantage of linkage effects.

High tech manufacturers are locating in rural areas and the potential for future growth in this sector is good. The impacts of these firms on the local economy, however, will vary depending on whether the establishment is a branch or unit plant. Community development leaders need to consider these trade-offs when designing industrialization programs.

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## Appendix

### High technology industries

- |      |                                                                     |      |                                                                        |
|------|---------------------------------------------------------------------|------|------------------------------------------------------------------------|
| 2812 | Alkalies & chlorine                                                 | 3579 | Office machines                                                        |
| 2813 | Industrial gases                                                    | 3622 | Industrial controls                                                    |
| 2816 | Inorganic pigments                                                  | 3623 | Welding apparatus                                                      |
| 2821 | Plastic materials, synthetic resins, and nonvulcanizable elastomers | 3624 | Carbon & graphite products                                             |
| 2822 | Synthetic rubber                                                    | 3629 | Electrical industrial apparatus                                        |
| 2823 | Cellulosic man-made fibers                                          | 3651 | Radio & TV receivers                                                   |
| 2824 | Synthetic organic fibers                                            | 3652 | Phonograph records & tapes                                             |
| 2831 | Biological products                                                 | 3661 | Telephone & telegraph apparatus                                        |
| 2833 | Medicinal chemicals & botanical products                            | 3662 | Radio-TV transmitting                                                  |
| 2834 | Pharmaceutical preparations                                         | 3671 | Radio & TV electron tubes                                              |
| 2861 | Gum & wood chemicals                                                | 3672 | Cathode ray TV picture tubes                                           |
| 2865 | Coal tar, crudes & cyclic intermediates, dyes & organic pigments    | 3673 | Semi-conductors                                                        |
| 2891 | Adhesives & sealants                                                | 3675 | Electronic capacitors                                                  |
| 2892 | Explosives                                                          | 3676 | Resistors for electronic apparatus                                     |
| 2893 | Printing ink                                                        | 3677 | Electronic coils, transformers                                         |
| 2895 | Carbon black                                                        | 3678 | Connectors for electronics                                             |
| 2899 | Chemicals & chemical preparation n.e.c.                             | 3679 | Electronic components, n.e.c.                                          |
| 2911 | Petroleum refining                                                  | 3721 | Aircraft                                                               |
| 3482 | Small arms ammunition                                               | 3724 | Aircraft engines & engine parts                                        |
| 3483 | Ammunition                                                          | 3728 | Aircraft parts & equipment, n.e.c.                                     |
| 3484 | Small arms                                                          | 3761 | Guided missiles & space vehicles                                       |
| 3489 | Ordinance & accessories                                             | 3764 | Guided missiles & space propulsion units                               |
| 3511 | Steam, gas, hydraulic turbines                                      | 3769 | Guided missiles & space parts & equipment, n.e.c.                      |
| 3519 | Internal combustion engines                                         | 3811 | Engineering, lab, science research instruments                         |
| 3531 | Construction machinery & equipment                                  | 3822 | Automatic controls for regulating residential & commercial environment |
| 3532 | Mining machinery                                                    | 3823 | Industrial instruments for measuring and control of process variables  |
| 3533 | Oil machinery                                                       | 3824 | Totalizing fluid meters & counting devices                             |
| 3534 | Elevators & moving stairways                                        | 3832 | Optical instruments & lenses                                           |
| 3535 | Conveyors                                                           | 3841 | Surgical and medical instruments                                       |
| 3536 | Hoists, industrial cranes                                           | 3842 | Orthopedic & surgical supplies                                         |
| 3537 | Industrial trucks, tractors, trailers, stackers                     | 3843 | Dental equipment                                                       |
| 3561 | Pumps & pumping equipment                                           | 3851 | Ophthalmic goods                                                       |
| 3562 | Ball & roller bearings                                              | 3861 | Photographic equipment                                                 |
| 3563 | Air & gas compressors                                               | 3873 | Watches, clocks                                                        |
| 3564 | Blowers & exhaust & ventilation fans                                |      |                                                                        |
| 3565 | Industrial patterns                                                 |      |                                                                        |
| 3566 | Speed changers, industrial high-speed gears                         |      |                                                                        |
| 3567 | Industrial process furnace & ovens                                  |      |                                                                        |
| 3568 | Mechanical power transmission equipment                             |      |                                                                        |
| 3569 | General industrial machinery                                        |      |                                                                        |
| 3572 | Typewriters                                                         |      |                                                                        |
| 3573 | Electronic computing equipment                                      |      |                                                                        |
| 3574 | Calculating & accounting machines                                   |      |                                                                        |
| 3576 | Scales & balances                                                   |      |                                                                        |

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